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PERFORMANCE WORK STATEMENT
STREAMS II
TASK ORDER SOLICITATION PR-ORD-12-01935

TITLE: "Nanomaterials and Drinking Water Treatment: State of the Science, Technology, and Practice"

TOCOR: **Paul Shapiro**
ORD/NCER/TED
(703) 347-8106
shapiro.paul@epa.gov

Alternate TOCOR: **Marti Otto**
ORD/NCER/TED
(703) 603-8853
otto.marti@epa.gov

Period of Performance: 25 Weeks

I. INTRODUCTION

In March 2010 the EPA Administrator announced a new Drinking Water Strategy (http://water.epa.gov/lawsregs/rulesregs/sdwa/dwstrategy/index.cfm). The Strategy has two complementary goals that are directly relevant to this task. These are:

- Foster development of new drinking water technologies to address health risks posed by a broad array of contaminants.

- Address contaminants as groups rather than one at a time so that enhancement of drinking water protection can be achieved cost-effectively.

EPA sets standards for approximately 90 contaminants and indicators in drinking water. The presence of indictors at a level outside of specified limits may reflect a problem in the treatment process or in the integrity of the distribution system. (http://water.epa.gov/drink/contaminants/basicinformation/index.cfm)

National Primary Drinking Water Regulations (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. (http://water.epa.gov/drink/contaminants/index.cfm)

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards. (http://water.epa.gov/drink/contaminants/index.cfm#Secondary)

Drinking water systems use treatment technologies to meet these standards. The systems range from point-of-use devices (e.g., a filter on an in-home water tap) to small systems that serve less

than 10,000 people to systems that serve large municipalities and populations. The technologies range from simple technologies that address easily treated contaminants; to trains of technologies which may include advanced treatment technologies that treat various types of contaminants, some of which may be difficult to treat; to technologies that address pressing needs (e.g., desalination).

Tried and true technologies are safest for treatment works to continue to use or adopt, but innovative technologies are needed that perform better, require less maintanence, are easier to operate, last longer, and cost less. Innovative technologies may also be needed if existing technologies cannot treat drinking water so it complies with Federal, state, and local standards.

Industry, universities, and others are trying to develop and utilize nanomaterials for a variety of consumer, manufacturing, and other applications. They perform a variety of functions. For example, they attempt to develop new types of nanomaterials that have enhanced properties, apply new nanomaterials—or nanomaterials that have already been used for a different application—for new applications, manufacture in quantity the nanomaterials themselves and the technologies of which they are made a part, and foster adoption and widespread use of the technologies.

The use of nanomaterials is rapidly emerging as an important element of drinking water treatment (e.g., through incorporation in membranes to improve filtration). Its coming of age can be marked by the $50,000 2011 Clarke Prize for Outstanding Achievement in Water Science and Technology lecture on "Nanomaterials, Water, and the Directed Self-Assembly of Environmentally Responsible Industries," given by Mark Wiesner (Duke University). Professor Wiesner's research has been supported in part by EPA STAR research grants (http://www.nwri-usa.org/documents/2011ClarkeLectureforweb.pdf).

In addition, applicants to recent NCER STAR and Small Business Innovation Research (SBIR) solicitations have proposed utilizing nanomaterials and graphene for drinking water treatment. As a result, a grant was awarded under the recent STAR RFA for innovative water treatment technologies for small drinking water systems for "Research and Demonstration of Electrospun Nanofiber Filters: Multifunctional, Chemically Active Filtration Technologies for Small-Scale Water Treatment Systems" (University of Iowa). (http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/9609/report/0)

The Federal government, through the National Nanotechnology Initiative (NNI), coordinates the nanotechnology activities of 25 Federal agencies, 15 of which are engaged in nanotechnology research. With the support of these agencies, nanotechnology R&D is taking place in academic, government, and industry laboratories across the United States. An NNI Strategic Plan (2011) provides guidance for agency leaders, program managers, and the research community regarding planning and implementation of nanotechnology R&D investments and activities. (http://www.nano.gov/node/581)

EPA's ORD National Center for Environmental Research (NCER) has funded various types of nano-related research. An overview can be found at:

http://www.epa.gov/ncer/nano/research/index.html. To search the NCER database for nano-related research projects go to: www.epa.gov/ncer.

Recent NCER-funded research has focused on determining the toxicity and environmental and human health risks of using nanomaterials. In particular NCER has undertaken research on the fate and effects of nanomaterials in the aquatic environment, the results of which can be found at www.epa.gov/ncer. In general, it is not the purpose of this project to determine the human health and environmental risks associated with the manufacture and use of nanomaterials that may enter the environment.

An important exception, however, is the opportunity to take advantage of existing knowledge about how the structure, surface characteristics, stability during use, and other aspects of nanomaterials affect their toxicity and transport and fate in the environment. Whenever possible in the course of assessing specific nanomaterials and nanotechnologies, the contractor shall utilize this information and explain how specific modifications in design, structure, and use could reduce the potential environmental and human health risks of using those materials and technologies. This information shall be included in the database described in Section III, #6.

II. OBJECTIVE

The objective of this task order is to produce an up-to-date, comprehensive, accurate, well-documented, and easy to understand report on the state of the science, technology, and practice of using nanomaterials and nanotechnologies to treat drinking water. The contractor shall review and assess drinking water treatment systems and technologies and nanomaterials and nanotechnologies that are currently used or could be used to treat contaminants in drinking water, and utilize appropriate tables and graphics in doing so. The contractor shall create a database of the materials and technologies with their characteristics and capabilities that will be easy for EPA to use and update in the future. This information shall be included in the database described in Section III, #6.

Definitions to Be Used in Carrying Out the Project

The underlined terms in the paragraph above are defined below. The contractor shall adhere to and utilize these definitions throughout the project.

The term "science, technology, and practice" shall be implemented by reviewing and assessing all systems, materials, and technologies at the following stages of the technology development continuum ("continuum"): research, development, demonstration, commercialization, and utilization. (For information on the concept of the technology development continuum see: http://www.epa.gov/ncer/publications/venturecapital/intraagencycoord.pdf)

For the purposes of this task, a "nanomaterial" is a man-made or naturally-occurring carbon- or non-carbon-based nanoparticle, including fullerenes, graphenes, and any other novel or related nano-scale (1 – 100 nm in at least one dimension) material. A "nanotechnology" is a device or system that (i) incorporates one or more nanomaterials, (ii) is or could be used for a particular application (e.g., treating drinking water), and (iii) takes advantage of one or more enhanced properties of the nanomaterial(s).

The term "review and assess" shall include but not be limited to identification, description, characterization, and analysis of the technical properties, design, stage of continuum, applications, manufacture, contaminants treated, performance, usage, ways to decrease toxicity and increase stability, and cost of materials and technologies, as well as analysis of (a) the barriers to and opportunities for improving their design and performance and (b) the limitations on and opportunities for their wider use.

"Graphics" shall include pictures, diagrams, drawings, and other types of illustration that will assist the reader in understanding the information in the report and create a visual record of the materials and technologies that are reviewed and assessed in the report.

"Database" shall mean a database management system or a database application, a construct created using the system or application software into which data can be entered, and the data that populate the construct.

III. REQUIREMENTS FOR PERFORMANCE OF THE TASK ORDER

The contractor shall fulfill the following requirements:

#1. Successfully carrying out this project will require combining expertise from two disparate fields that are just now coming into contact with one another—drinking water treatment and nanomaterials and nanotechnologies. As a result, the contractor shall have two key personnel devoted to this project: (1) at least one nationally-recognized expert on the design, development, manufacture, operation, and use of drinking water treatment systems and technologies and (2) at least one nationally-recognized expert on the design, development, manufacture, operation, and use of nanomaterials and nanotechnologies for the full range of consumer, manufacturing and other non-drinking water treatment applications (although in addition some knowledge related to drinking water treatment would be desirable if that were to be the case).

The contractor shall explain in its proposal how it will ensure that these key personnel will closely collaborate in performing all of the tasks identified in Section V, below, so that their complementary knowledge, experience, and skills will produce the best possible final report.

#2. The contractor shall seek information from the widest possible range of sources, which shall include but not be limited to: inventors, technology developers, entrepreneurs, nanomaterial manufacturers, technology manufacturers, technology users, Federal and State agencies, public and private sector laboratories, universities, non-profit entities, technology transfer organizations, incubators, industry associations, international aid organizations, foundations, conferences, trade shows, patents, published literature, reports, and web sites. The contractor shall explain in its proposal how it will perform this activity.

#3. The contractor shall seek information from foreign as well as domestic sources, since there are dozens of other countries that have nanotechnology R&D programs and the potential to create and commercialize nanotechnologies to treat drinking water, The contractor shall explain in its proposal how it will perform this activity.

#4. The contractor shall highlight from among the nanomaterials and nanotechnologies identified in this project any that the contractor or other well-qualified individuals think could be breakthrough or disruptive materials and technologies that might result in their widespread adoption for treatment of various contaminants in drinking water.

#5. The contractor shall identify for each specific nanomaterial and nanotechnology the groups of, as well as individual, contaminants in drinking water that it can treat.

#6. The contractor shall create a database of the water treatment systems and technologies, nanomaterials, and nanotechnologies identified during the performance of this project. The database shall contain the types of information included in the definition of "review and assess" in Section II. The database should enable easy creation of tables that will clearly convey their content when used to support the reviews and assessments performed in this project. The database should also be such that, following completion of this project, it will be easy for EPA to use—e.g., to create new tables and spreadsheets for further analyses and presentation preparation; to modify; and/or to add information to in the future. The database should also be inexpensive to operate. The contractor shall explain in its proposal how its proposed database (see definition in Section II) will meet these criteria.

#7. The contractor shall prepare a QAPP as part of this project (see Section IV and Section V, Task 1, below). The contractor shall provide in its proposal an annotated outline for the QAPP.

#8. The contractor shall include in its monthly progress reports the information collected during that month on water treatment systems and technologies, nanomaterials, and nanotechnologies in a form that can be easily reviewed by the Task Order-COR (TOCOR).

#9. The contractor shall have bi-weekly teleconferences with the TOCOR to discuss progress, direction of the research, issues that have arisen, and any other topics that affect the efficient and effective completion of the project. The contractor shall prepare a brief summary of the decisions and commitments made in the teleconference and submit the summary to the TOCOR within five (5) working days after the teleconference. The TOCOR may alter the frequency of these teleconferences.

IV. QUALITY ASSURANCE

Some of the work in this project requires the use of primary and/or secondary data. Consistent with the Agency's quality assurance (QA) requirements, the contractor shall prepare a complete Quality Assurance Project Plan (QAPP) to assure the quality of the data used under this task order (see Section V, Task 1, below). Work on these tasks cannot proceed until the contractor receives notification of QAPP approval from the TOCOR via e-mail. The quality assurance requirements shall be addressed in the work plan and monthly progress reports as specified under Task 1, below.

V. DESCRIPTION OF TASKS

Task 1: Preparation of Quality Assurance Project Plan (QAPP)

The contractor shall prepare a QAPP in accordance with applicable sections of EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5; EPA/240/B-01/003, http://www.epa.gov/quality/qs-docs/r5-final.pdf).

The contractor shall develop a QAPP that describes how each task shall be carried out. It shall include a schedule, staffing plan, level of effort (LOE), and cost estimate for each task, the contractor's key assumptions on which the staffing plan and budget are based, and qualifications of proposed staff. If a subcontractor(s) is proposed, the contractor shall describe how it will manage the subcontractor(s) work and costs.

The monthly progress report shall indicate, in a separate QA section, whether significant QA issues have been identified and how they are being resolved.

The QAPP shall be submitted within 2 weeks after notification of the award.

NOTE: For Tasks 2, 3, 4, and 5 the contractor shall provide the results to the TOCOR using the approved database construct as indicated in Section VI.

Task 2: Review and Assess Drinking Water Treatment Systems and Technologies

The contractor shall review and assess, as defined in Section II, above, (a) the types of point-of-use, small-scale, and larger-scale drinking water treatment systems currently used to treat various types of contaminants in drinking water, (b) the types of technologies that those systems currently use to treat contaminants—especially groups of contaminants—in drinking water, and (c) technologies that are currently at the earlier stages of the continuum (i.e., prior to utilization).

Task 3: Review and Assess Nanomaterials, Including Those Used in Treating Drinking Water

The contractor shall review and assess:

(1) The full range of nanomaterials that currently exist at the stages of the continuum, including a description of how they are created.

(2) The contractor shall include in a sub-section nanomaterials that have been or could be used as part of nanotechnologies that treat drinking water, including a description of how they are created.

Task 4: Review and Assess Nanotechnologies, Including Those Used in Treating Drinking Water

The contractor shall review and assess:

(1) The full range of nanotechnologies that currently exist at each stage of the continuum.

(2) The contractor shall include in a sub-section those nanotechnologies that have been or could be used to treat drinking water.

Task 5: Preparation of the Database and Appendices

The contractor shall:

(1) Create a database as described in Section III, #6, above.

(2) Create an Appendix 1 that describes in separate subsections each nanotechnology identified in the report that is being or could be used to treat drinking water (these technologies should all be included in the database). The description shall include the name of the technology, the name of the researcher and developer, the name of the manufacturer, the sources and amounts of money used in each stage of the continuum, the uses of the technology, how widespread the uses are, the contaminants addressed, the technology's performance (including how that was determined), limitations on performance, potential growth in use and new applications, ways by which it could be made less toxic and more stable, and other relevant information. The description shall be accompanied by graphics of the technology and its components. Appendix 1 shall be due with Task 4.

(3) Create an Appendix 2 that explain how to access, use, and add information to the database and create an Appendix 3 that is a printout of the database.

(4) Use the information in the database and Appendix 1 to create tables and graphics that shall accompany and—along with other relevant information for which the sources are well-documented in the report—be the basis for the reviews and assessments in the report. The tables shall be presented in ways that enable easy overviews and comparisons of information.

NOTE: EPA will provide comments on the Draft of Populated Database and the Draft of Appendix 1 which the contractor shall incorporate before Final Populated Database and Final Appendix 1 acceptance.

Task 6: Preparation of Final Report, PowerPoint Presentation, and One-Page Summary

The contractor shall deliver a Final Report, a PowerPoint Presentation, and a One-Page Summary. The contractor shall:

(1) Organize the Final Report in the following manner:

Executive Summary
Introduction
- --Background
- --Purpose
- --Methodology

Review and Assessment of Drinking Water Treatment Systems and Technologies

Review and Assessment of Nanomaterials, Including Those Used in Drinking Water Treatment
Review and Assessment of Nanotechnologies, Including Those Used in Drinking Water Treatment
Conclusions
Acronyms and Abbreviations
Glossary
Bibliography
Appendices

1. Description of Each Nanotechnology
2. How to Access, Use, and Add Information to the Database
3. Printout of Data in the Database

(2) Include in the body of the report and the Appendices graphics that will (a) assist the reader in understanding the information in the report and (b) create a visual record of the materials and technologies that are reviewed and assessed in the report.

(3) Create a PowerPoint presentation to inform management and technical audiences about the project that includes, for example, the purpose, methods, findings, graphics of representative nanomaterials and nanotechnologies that are being used to treat drinking water, and conclusions.

(4) Create a one-page written summary of the project that captures the information in the PowerPoint presentation in a fashion that could be used to inform management, technical audiences, and communication professionals about the project.

NOTE: EPA will provide comments on the Draft of the Report, PowerPoint Presentation, and One-Page Summary that the contractor shall incorporate before Final Report, PowerPoint Presentation, and One-Page Summary acceptance.

VI. PROJECT SCHEDULE

Deliverables	Due Dates (Weeks after award)
Preparation of QAPP (Task 1)	2
Database Construct (Task 5)	6
Results of Review and Assess Drinking Water Treatment Systems and Technologies (Task 2)	8
Results of Review and Assess Nanomaterials, Including Those Used in Treating Drinking Water (Task 3)	13
Results of Review and Assess Nanotechnologies, Including Those Used in Treating Drinking Water (Task 4)	17

Draft of Populated Database (Task 5)	17
Draft of Appendix 1 that Describes Each Nanotechnology (Task 5)	17
Draft of Report, PowerPoint Presentation, and One-Page Summary (Task 6)	21
Final Report, PowerPoint Presentation, and One-Page Summary (Task 6)	25

NOTE: EPA will provide comments on Task 2, 3, 4, and 5 within 2 weeks of receipt. The contractor shall incorporate comments into subsequent deliverables.

The contractor shall deliver the database to EPA on a CD and/or other mutually agreed digital or electronic means.

The contractor shall deliver the Final Report, PowerPoint Presentation, and One-Page Summary to EPA as follows: as five (5) hard copies and on a CD and/or other mutually agreed digital or electronic means. The contractor shall use MS Word to create written documents.